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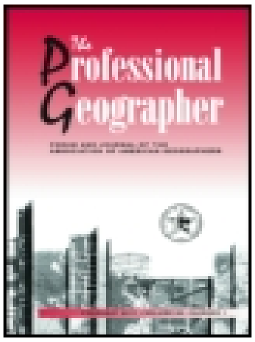

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From Microtoponyms to Landscape Using Semantics, Location, and Topography: The Case of *Wald, Holz, Riet,* and *Moos* in St. Gallen, Switzerland

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To explore landscape properties using language, we analyzed the semantics and associated physical properties of four generic landscape terms through spatially located microtoponyms in the Swiss canton of St. Gallen. We applied quantitative methods to physical and etymological data to understand how four common generic terms (*Wald*, *Holz*, *Riet*, and *Moos*) were used in microtoponyms in the canton. We observe that the meaningful elements associated with those generic terms characterize general properties of landscape independent of the feature type as well as specific properties linked to the feature. Moreover, using a toponym taxonomy, we compared co-occurrences of different terms (e.g., those associated with spatial relationships or vegetation) for the four generic terms. *Holz*, which we argue is more associated with land use than land cover, was markedly different in naming patterns from the other three generic terms, and we suggest that this was driven by a distinction between nature and culture. We conclude that the act of naming natural features is influenced not only by properties of the referent but also by broader scale landscape patterns and cognitive associations with landscape terms. **Key Words: ethnophysiography, landscape, language, microtoponyms.**

为使用语言的地景属性，我们通过瑞士圣加仑州在空间上定位的微地名研究，分析四大类地景专有名词的语意学与相关的物理属性。我们将量化方法应用于物理与词源学数据，以理解四大常见的类属专有名词（Wald、Holz、Riet 与 Moos）在该州微地名研究中的使用方法。我们观察到，与这些类属专有名词相关的有意义元素，描绘了不受特色种类以及与该特色相关的特定属性的地景一般属性。此外，我们运用地名分类，比较四大类属概念中不同概念的共同存在（例如与空间关系或植被有关的概念）。我们主张，Holz 较土地覆盖而言更关乎土地使用，而该概念与其他三个类属概念的命名模式显着不同，我们并主张，这是由自然与文化的分野所导致。我们于结论中主张，命名自然特色的行为，不仅受到指示对象的属性所影响，亦受到更大尺度的地景模式与地景概念的认知关联所影响。**关键词：民族志生理仪，地景，语言，微地名研究。**

Para explorar las propiedades del paisaje por medio del lenguaje, analizamos la semántica y las propiedades físicas asociadas de cuatro términos genéricos del paisaje a través de microtopónimos espacialmente localizados en el cantón suizo de St. Gallen. Aplicamos métodos cuantitativos a los datos físicos y etimológicos para entender cómo cuatro términos genéricos (*Wald*, *Holz*, *Riet y Moos*) se usaron en microtopónimos en el cantón. Observamos que los elementos significativos asociados con aquellos términos genéricos caracterizan las propiedades generales del paisaje con independencia del tipo de rasgo lo mismo que de las propiedades específicas vinculadas al rasgo. Aún más, usando una taxonomía de topónimos, comparamos las co-ocurrencias de diferentes términos (e.g., aquellas asociadas con relaciones espaciales o con vegetación) para los cuatro términos genéricos. El término *Holz*, que nosotros sostenemos se asocia más con el uso del suelo que con la cubierta de la tierra, era ostensiblemente diferente al nombrar patrones de los otros tres términos genéricos, lo cual sugerimos estuvo determinado por una distinción entre naturaleza y cultura. Concluimos que el acto de designar rasgos naturales está influido no solo por las propiedades del referente, sino además por patrones del paisaje a escala más amplia y por asociaciones cognitivas con los términos del paisaje. **Palabras clave: etnofisiografía, lenguaje, microtopónimos, paisaje.**

What does language tell us about landscape? To what extent can we understand landscape and the diverse ways in which it is conceptualized through the names assigned to landscape features? The recently emerged interdisciplinary research endeavor of ethnophysiography answers such questions by combining anthropological, linguistic, and geographic perspectives. It has demonstrated how, by taking a more critical and reflexive stance toward the investigation of how people from different language groups and cultures conceptualize landscape, and by integrating knowledge from different fields it is possible to gain insights missed by previous monodisciplinary efforts (Mark et al. 2011a). Indeed, by linking landscape to language explicitly, ethnophysiography has concentrated on, first, identifying the sorts of objects that are perceived in the landscape (Levinson 2003; Smith and Mark 2003; Heyes 2011) and, second, the links between these objects and their names (Brown 2008; Jett 2011). Importantly, the focus is not on individual names or objects but rather on broad patterns of language use and its variation between cultures.

Inspired by the productive outputs of this community, we seek to answer similar questions in a different setting. Ethnophysiography has been practiced almost exclusively with consultants drawn from indigenous peoples (Mark et al. 2011b) who are supposed to be more connected to the use of language in parceling up and naming of their environment. Such ethnographic methods, however, require, first, that informants are capable of

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answering the questions posed and, second, with their focus on bottom-up research, they cannot be used to explore existing data such as place-name gazetteers.

Recognizing this limitation, Feng and Mark (2017) took a data-driven approach. They used place-names associated with particular landscape types (mountain and hill) in two languages and linked their results to geomorphometry as expressed by a terrain model. Their work and other similar work (e.g., Derungs et al. 2013) form the starting point for this article, where we also use lists of place-names to explore this question: "What is the relation between landscape terms (common nouns) and place-names (proper nouns)?" (Burenhult and Levinson 2008).

Indeed, place-names, or more formally *toponyms*, are fundamental to human communication (Basso 1988). They are not assigned arbitrarily, in terms of either the objects named or the names given to objects (Radding and Western 2010). In geography, their use and assignment are clearly important components of spatial cognition (Levinson 2003; Hećimović and Ciceli 2013). Because they persist historically, they have been used to explore land cover change (Conedera et al. 2007; Fagúndez and Izco 2016), and because naming is both a political and cultural act, they provide insights into societies (Alderman 2008; Rose-Redwood, Alderman, and Azaryahu 2010; Fuchs 2015). Finally, and perhaps more pragmatically, if toponyms can be associated with coordinates and extents, they can provide a powerful way to link texts to space (Leidner 2004; Purves and Derungs 2015). Toponyms are not only of interest to geographers, however. As a particular class of proper name, they have been extensively explored in linguistics from an equally wide range of perspectives. These range from philosophical discussions on the nature of properhood (Coates 2006; Nash 2015), through attempts to create taxonomies of toponym types (Gammeltoft 2005; Rennick 2005; Tent and Blair 2011) to cataloging and sensemaking of toponyms in historical linguistics.

In this article, we do not compare different languages or cultures but instead explore the potential of the semantics of a name and the properties of a location to understand landscape conceptualization. Similar to Feng and Mark (2017), we compare overlapping categories, but we do so in a single language (Swiss German). Our broad approach started from the premise that meaningful elements found in microtoponyms (e.g., *Berg* [mountain][1] as in *Uetliberg* or *Wald* [forest] as in *Schwarzwald*) encode information (Hollis and Valentine 2001).

Thus, rather than applying a simple categorization (cf. Feng and Mark 2017) from a toponym gazetteer to link microtoponyms to concepts, we start by exploring the etymology of meaningful elements found within microtoponyms. We used microtoponyms (in German *Flurnamen*) because they are a type of name given to individual land parcels (and not city names, street names, country names, etc.), which are often argued to be potential sources of environmental information (Thornton 1997; Seidl 2008; Villette and Purves 2018). They were defined by Tyroller (1996) as names given to nonpopulated places such as fields, mountains, forests, and other landscape features.

We hypothesized that meaningful elements found in microtoponyms have some interpretable sense not in the act of reference to an individual referent but rather when analyzed as the properties associated with a group of referents (cf. Coates 2006). Specifically, we used a database of 17,598 microtoponyms from the Swiss canton of St. Gallen. To explore our hypothesis, we performed analyses on two commonly occurring pairs of meaningful elements.

- First, we compared two meaningful elements both associated with tree-covered areas (*Wald* and *Holz* [wood]). Although both terms refer to similar land cover properties, in German as in English there is semantic ambiguity in the difference between a forest and a wood, which we wished to investigate.
- Second, we analyzed two further meaningful elements (*Riet* and *Moos*; both of these terms are associated with poorly drained, marshy locations, although the former is sometimes also assumed to be associated with cleared areas of forest). We set out to explore whether we could find clear differences in their usage in our study area.

Study Area and Data

The canton of St. Gallen, in northeastern Switzerland (Figure 1), is a typical Swiss canton in terms of landscape diversity, with an area of 1,951 km^2, of which 48 percent is used for a mix of agricultural practices, ranging from intensive arable farming in the low-lying parts of the canton to transhumance in the more mountainous regions. A further 32 percent of the canton is forested, and it is worth noting that forest is strongly protected in Switzerland, in part due to the protection it offers from natural hazards in steep mountainous regions, and thus recent changes in forest area are minimal. Finally, 10 percent of the canton is urban, with an eponymously named capital city having some 160,000 inhabitants. Elevations range from 398 m to 3,247 m. In modern-day St. Gallen, Swiss German (Alemannic) dialects are spoken, and written documents are in Swiss Standard German. Historically, some Romansch was spoken in the east of the canton. Toponyms are therefore a mix of Swiss German, standard German, and Romansch (Canton of St. Gallen 2018).

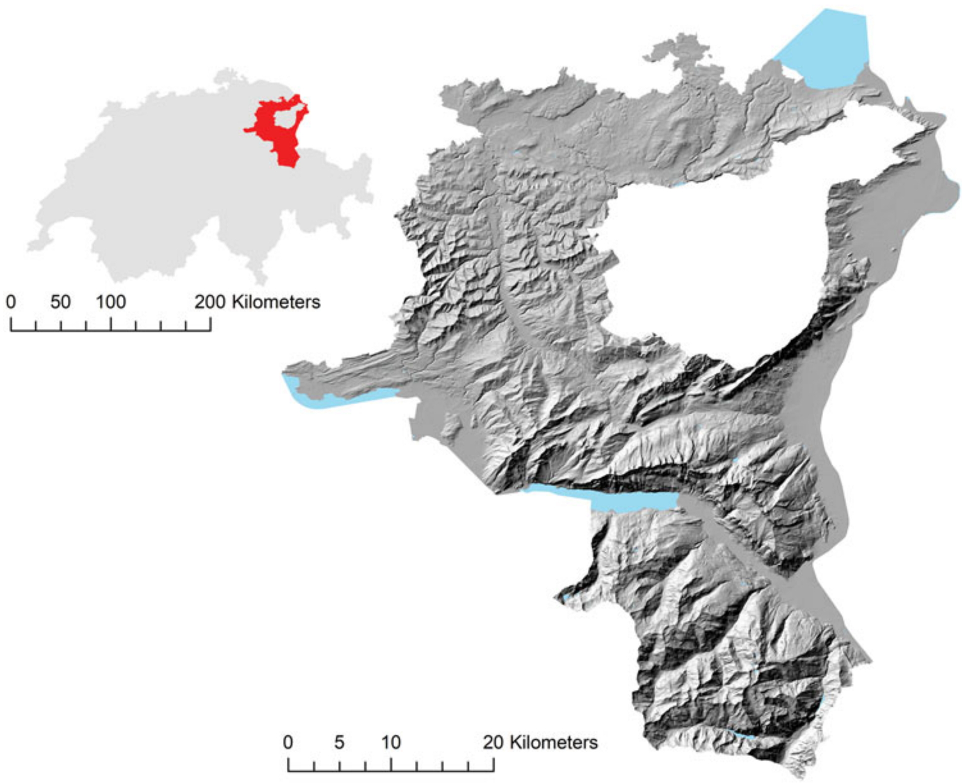

Figure 1 *Study area: Location and relief of the canton of St. Gallen in Switzerland. Note the variation in topography from the undulating north to the mountainous south and the very flat Rhine Valley to the east. Source: Federal Office of Topography (swisstopo 2018).*

To explore microtoponyms in St. Gallen, we used two data sets. The first of these was a very fine-grained set of microtoponyms associated with individual land parcels used by the cadastral authorities of the canton containing 17,598 microtoponyms and covering the whole canton. These data were collected by individual communes and, as such, the size of the polygons referred to by microtoponyms the level of detail as a function of land cover and land use, and the ways in which toponyms are recorded (e.g., the spelling used with respect to Swiss German, for which no formal orthographic rules exist) vary between communes. Of the 17,598 names contained in the cantonal data set, 54 percent were unique, whereas the remainder occurred at least twice. Some microtoponyms are very common; for example, *Riet* occurs thirty-three times. The mean area of the polygons associated with microtoponyms was 11.2 ± 2.3 ha. The second data set took advantage of ongoing linguistic research on the etymology of microtoponyms in the canton of St. Gallen. Linguists engaged in this task have created a lexicon containing common meanings of toponyms and parts thereof, based on extensive historical research. It contains some 3,378 meaningful elements and their potential related meanings. As an illustration, the toponym *Gruenholz* contains two identifiable meaningful elements: *Gruen* and *Holz*. *Holz* is, in our lexicon, associated with a wooded area, whereas *Gruen* is linked to the color green. Thus, using the lexicon it is possible to extract the potential meaning of individual microtoponyms by extracting meaningful elements and comparing these to lexicon entries. It is important, however, to note that some meaningful elements are associated with multiple meanings (e.g., *Roth* may refer to the color red and a family name) and that not all terms extracted from microtoponyms are found in the lexicon. To link microtoponyms and their associated polygons to the environment we used a 25-m digital elevation model (DEM) to derive a range of terrain-related parameters.

We selected, as discussed in the Introduction, four landscape terms to investigate their local use: *Wald* and *Holz* (associated with wooded areas) and *Riet* and *Moos* (associated with marshy or poorly drained areas). In Table 1 we show the count for each of these terms in our microtoponym data set, along with their rank overall as a meaningful element. *Wald* is the second most common meaningful element, surpassed only by *Berg* in our data. For each term, we also list alternative spellings used to

Table 1 Rank and count of microtoponyms in database

Meaningful element	Alternative spellings	Rank in microtoponym data set overall	Count of microtoponyms containing meaningful element
Wald	*Wäld*	2	856
Holz	*Hölz*	10	397
Riet	*Ried*	11	352
Moos	*Möös, Mos, Mös, Moor*	22	228

Table 2 MEs and their position in microtoponyms

ME	ME as last part of the name	ME as unique element of the name	ME occurring before another collocate
Example	*Rotholz*	*Moos*	*Waldhügel*
Wald	761 (89%)	18 (2%)	77 (9%)
Holz	333 (84%)	23 (6%)	41 (10%)
Riet	209 (59%)	62 (18%)	81 (23%)
Moos	131 (57%)	64 (28%)	33 (14%)

Note: ME = meaningful element.

extract candidate microtoponyms from the original data set. All four terms are common, each occurring more than 200 times, an important prerequisite for our data-driven approach.

Analyzing Microtoponyms in St. Gallen

Our analysis of microtoponyms in St. Gallen had three main components. First, we selected all microtoponyms containing relevant meaningful elements and the associated polygons as described earlier (Table 1). Second, we analyzed the semantics of the extracted microtoponyms by comparing terms found in the selected microtoponyms with the linguistically informed lexicon. Third, we used geomorphometry to explore topographic properties of the polygons associated with the selected microtoponyms.

To analyze ways in which our four meaningful elements were described, we used our lexicon to identify commonly occurring collocates (cf. Villette and Purves 2018), iteratively extracting all meaningful elements from each microtoponym as a function of substring length in our lexicon.

Linguistic Aspects

Structure. Table 2 illustrates key properties of the structure of microtoponyms in terms of the position of the meaningful element under analysis and the number of collocates found in our lexicon. More than 80 percent of microtoponyms containing our search terms either end with this term or use it uniquely (e.g., *Rotholz* [Red Wood] or *Moos*). According to Gammeltoft (2005), this implies that these terms have a "classifying function"—in other words, that the referents are likely to be (or have been) instances of the meaningful element (i.e., *Rotholz* is likely to refer to a wooded area). Interestingly, *Riet* and *Moos* are used much more commonly as microtoponyms in isolation (18 percent and 28 percent of instances) than *Wald* and *Holz* (2 percent and 6 percent, respectively), suggesting that these microtoponyms are already significantly distinctive within a locality to uniquely identify a referent. More commonly, though, other terms are used to increase the specificity (and thus distinctiveness) of the microtoponym, indicating what Gammeltoft called "characteristics of the locality."

The use of our meaningful elements as the first or second part of a name (meaningful element occurring before another collocate) might be considered characteristics of a different instance (e.g., *Waldhügel* [Forest Hill]). This structure is much rarer, indicating that our choice of meaningful elements is likely a good one to explore the semantics associated with instances of these categories.

Table 3 shows the number of collocates with which we can explore these semantics. Note that the counts are indicative of the number of matches found with our lexicon. A count of one includes microtoponyms where our terms are not used alone but no matching term of the associated term was found in our lexicon (around 9 percent of our microtoponyms belong to this category). Thus, for 91 percent of microtoponyms, meaningful elements were either used alone or collocated with other meaningful elements listed in our lexicon. Moreover, considering that around 80 percent use the meaningful element under analysis as the last part of a name, we conclude that further analysis of the semantics of collocated meaningful elements is a sensible next step.

Meaningful Element Classification. Having established that microtoponyms contained rich information, potentially related to the properties of individual referents, our aim was then to explore how our four meaningful elements were described and to identify differences and similarities in the act

Table 3 *Number of matches found between meaningful elements and collocates in our lexicon*

	Unique	1*	2	3	4
Example	*Moos*	*Tam¦moos*	*Rötis¦riet*	*Bären¦boden¦wald*	*Vorder¦langen¦büel¦holz*
Wald	18	186	533	117	2
Holz	23	52	293	25	4
Reit	62	52	224	13	1
Moos	64	32	121	11	0

Note: *1 means that a term was not found in our lexicon.

Table 4 *Gammeltoft classification applied to Wald and Holz, Riet and Moos collocated elements*

Gammeltoft classification	*Wald* count	*Holz* count	*Riet* count	*Moos* count
I. Relationship	**237 (30.6%)**	**162 (45.5%)**	**86 (34.0%)**	**33(23.7%)**
a. Topographical	**182 (23.5%)**	**131 (36.8%)**	**63 (24.9%)**	**23 (16.5%)**
i. Characterization of the location in relation to name-bearing location	13 (1.7%)	12 (3.4%)	6 (2.4%)	1 (0.7%)
ii. Characterization of the location in relation to a non-name-bearing location	**124 (16.0%)**	**76 (21.3%)**	**41 (16.2%)**	**17 (12.2%)**
iii. Characterization of the location by means of its relative position	45 (5.8%)	**43 (12.1%)**	16 (6.3%)	5 (3.6%)
b. Institutional and administrative	32 (4.1%)	15 (4.2%)	9 (3.6%)	3 (2.2%)
c. Association to a person	23 (3.0%)	15 (4.2%)	11 (4.3%)	7 (5.0%)
d. An external event	0	1 (0.3%)	3 (1.2%)	0
II. Quality	**353 (45.5%)**	**141 (39.6%)**	**104 (41.1%)**	**75 (54.0%)**
a. Size	11 (1.4%)	8 (2.2%)	14 (5.5%)	8 (5.8%)
b. Shape	**155 (20.0%)**	**42 (11.8%)**	**49 (19.4%)**	**27 (19.4%)**
c. Color	9 (1.2%)	15 (4.2%)	2 (0.8%)	4 (2.9%)
d. Age	4 (0.5%)	5 (1.4%)	1 (0.4%)	4 (2.9%)
e. Material or texture	23 (3.0%)	1 (0.3%)	8 (3.2%)	3 (2.2%)
f. That which exists at or near	**122 (15.7%)**	**62 (17.4%)**	23 (9.1%)	**21 (15.1%)**
i. Creature	33 (4.3%)	12 (3.4%)	6 (2.4%)	6 (4.3%)
ii. Plant growth	60 (7.7%)	**47 (13.2%)**	12 (4.7%)	10 (7.2%)
iii. Inanimate objects	29(3.7%)	3 (0.8%)	5 (2.0%)	5 (3.6%)
g. Perceived qualities	29 (3.7%)	8 (2.2%)	7 (2.8%)	8 (5.8%)
III. Usage	**167 (21.5%)**	**53 (14.9%)**	**60 (23.7%)**	**31 (22.3%)**
Don't know	18 (2.3%)	0	3 (1.2%)	0

Note: Bold text indicates more than 10 percent of collocates.

of naming these features. Thus, we first classified collocates according to the taxonomy proposed by Gammeltoft (2005; see the first column of Table 4). Gammeltoft's taxonomy was created to better understand motivation in naming, is claimed to have no overlapping categories, fit well with European toponymy, and, important for our purposes, has three levels of classification allowing us to explore microtoponyms at different granularities (Tent and Blair 2011). Note, however, that we use the taxonomy to classify meaningful elements within microtoponyms and not toponyms themselves.

The upper level of the taxonomy has three classes: relationship, quality, and usage. The relationship class describes elements that describe, explicitly or implicitly, relationships to something external. Such external objects are subdivided into a second level and sometimes a third level of classification and might include other named locations, people, events, or landscape features as well as spatial prepositions (e.g., *Berg* in *Bergholz* [Mountain Wood] or *Ober* in *Oberwald* [Upper Wood]). The quality class captures inherent properties of the referent itself, such as its color, size, shape, and so on (e.g., *Rot* in *Rotmoos* [Red Marsh]). Finally, usage refers to ways in which a location is used (e.g., *Rüti* in *Rütiwald* [Cleared Forest]). Gammeltoft (2005) argued that this third class of usage was relatively rare and, in contrast to the classes associated with relationship and quality, did not refine the classification further.

To annotate our microtoponyms, both authors worked through all collocates associated with the four meaningful elements and, using the lexicon definitions, attempted to assign these to a single class. After an initial round of classification, we discussed cases where our attribution differed and resolved these. Disagreements most often resulted from ambiguity and metaphorical use (e.g., does a plant type refer to quality or usage, or does castle refer to an actual castle or a landform taking this shape?).

Table 4 shows the results of the annotation process. A number of points are worth making here. First, no single upper level class dominates any of our four meaningful elements and, indeed, contrary to Gammeltoft's (2005) assertion, we made recourse to usage fairly commonly. Second, at the second and third levels of the classification, we note a number of commonalities. All four elements are often associated with non-name-bearing locations; in our case, these are typically generic landscape features (e.g., *Bergholz*). This is in accord with our previous work, where we noted that for St. Gallen, microtoponyms often contained meaningful elements related to landscape features (Villette and Purves 2018). Shape is the most commonly attributed quality, again attesting to the importance of landscape form in characterizing these microtoponyms, whereas objects (in the form of plants, animals, and inanimate objects) are also often used to characterize referents. Third, we note two exceptions, both with respect to *Holz*. Here, the use of spatial relations is more common than for the other microtoponyms (e.g., *Oberholz* [Upper Wood]), and plant types (e.g., *Tannholz* [Pine Wood]) are also more common.

We initially selected *Wald* and *Holz* and *Riet* and *Moos* as complementary meaningful element pairs, where we assume implicitly from their semantics that these pairs are more related to one another than as general landscape features. If this is the case, we might also expect the pattern of usage of collocates to be more similar for these pairs; in other words, we might hypothesize that patterns of naming for *Holz* and *Wald* are likely to be similar, as are those for *Riet* and *Moos*. We explored this hypothesis by calculating correlations between the percentage (thus normalizing for overall counts) of elements assigned to second-level classes in Table 4. Table 5 shows the resulting correlations. These correlations suggest a different pattern. *Riet*, *Moos*, and *Wald* all follow much more similar patterns of naming than *Holz*, which has lower correlation values with all three of these meaningful elements. This result was hinted at in our descriptive analysis earlier, where we also noted some subtle differences in the classes associated with *Holz* related to the use of spatial relations and plant types. To explore the reasons for these differences in more detail, we now zoom in to explore not only the classes of meaningful elements associated with microtoponyms but the most common instances of meaningful elements.

Semantic Frequency. Having demonstrated that three of our classes of meaningful elements appear to use similar classes of association in naming, we can ask this question: Are the instances of these meaningful elements also similar? In other words, when choosing terms to describe shape, are the same ones used to characterize both *Moos* and *Riet?*

To do so, we selected the twenty most frequent meaningful elements collocated with *Wald*, *Holz*, *Riet*, and *Moos* and plotted these as word clouds representing both frequency and class (as defined in Table 4). Given the typical long tail distribution of toponyms, these most frequent terms represent more than 35 percent of all microtoponyms found in St. Gallen for *Wald* and 50 percent of microtoponyms for *Holz*, *Moos*, and *Riet*. Figure 2 illustrates such a word cloud for collocated meaningful elements. For *Wald* and *Holz*, ten meaningful elements were shared, relating to landscape elements (*Berg*, *Wis* [meadow], *Büel* [hill]), land use (*Rüti*, *Bann* [restricted area], *Chol* [charcoal]), plant type (*Buech* [beech]), spatial relationships (*ober*, *hinder* [behind]), and shape (*lang* [long]). Similarly, for *Moos* and *Riet* we found six shared elements related to landscape elements (*Wis*, *Wald*), land use (*Feld* [field], *Holz*), and shape (*lang*, *Egg* [edge]). Holz appears to be more commonly associated with tree types (as we found in our classification in Table 4) with additional prominent tree types (*Eich* [oak] and *Tane*). Globally, two terms (*lang* and *Wis*) are shared between all four meaningful elements.

Table 5 *Correlation (r^2) between normalized counts of meaningful elements as classified according to Table 4*

	Wald	Holz	Riet	Moos
Wald	x	0.7496	0.9219	0.9151
Holz		x	0.6969	0.5478
Riet			x	0.8637
Moos				x

Because our word clouds capture between 35 percent and 50 percent of all microtoponyms, and because we also observe that less than 50 percent of meaningful elements are shared between similar classes, we suggest that not only are general properties of the landscape are used to characterize microtoponyms but so are properties specific to each class.

Physical Properties of Microtoponyms and Their Extents

Because each microtoponym was associated with a polygon, we could calculate a range of physically based properties for individual names and summarize these according to the class of microtoponym. We did so for four attributes: area, mean elevation, standard deviation of elevation, and topographic wetness index (TWI). Area reflects the size of the landscape patch associated with individual microtoponyms and is illustrated in the box–whisker plots shown in Figure 3. As with all subsequent box plots, we plot the interquartile range (the box itself), median, range (the whiskers), and outliers (as individual points). We also plot, for comparative purposes, the area of all microtoponyms found in the canton of St. Gallen. When plotting areas, we note that *Wald* is associated with much larger parcels than the other three meaningful elements, whereas *Holz* is associated with relatively small parcels.

To explore whether simple physical properties of the terrain surface influenced the use of meaningful elements, we derived mean elevation and standard deviation in elevation from a 25-m resolution terrain model. The former reflects, at a simple level, the remoteness and mountainous extent of a polygon, with higher values likely to be more distant from the valley floor. The latter is a proxy for the roughness or steepness of a landscape and gives some indication of topographically complex locations (low values indicate flat locations).

Figure 4 illustrates that as well as being large, *Wald* polygons are distinctive in terms of their high elevation and steep or rough locations. *Holz* and *Moos* are found at similar elevations, although *Moos*

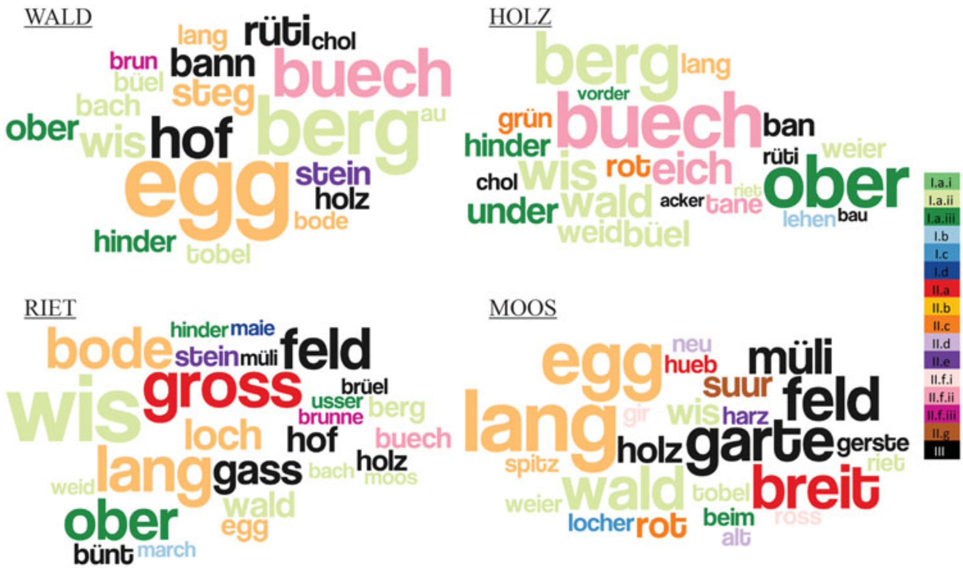

Figure 2 *Word cloud showing frequency (size) and classification (cf. Table 4) of meaningful elements collocated with Wald, Holz, Riet, and Moos.*

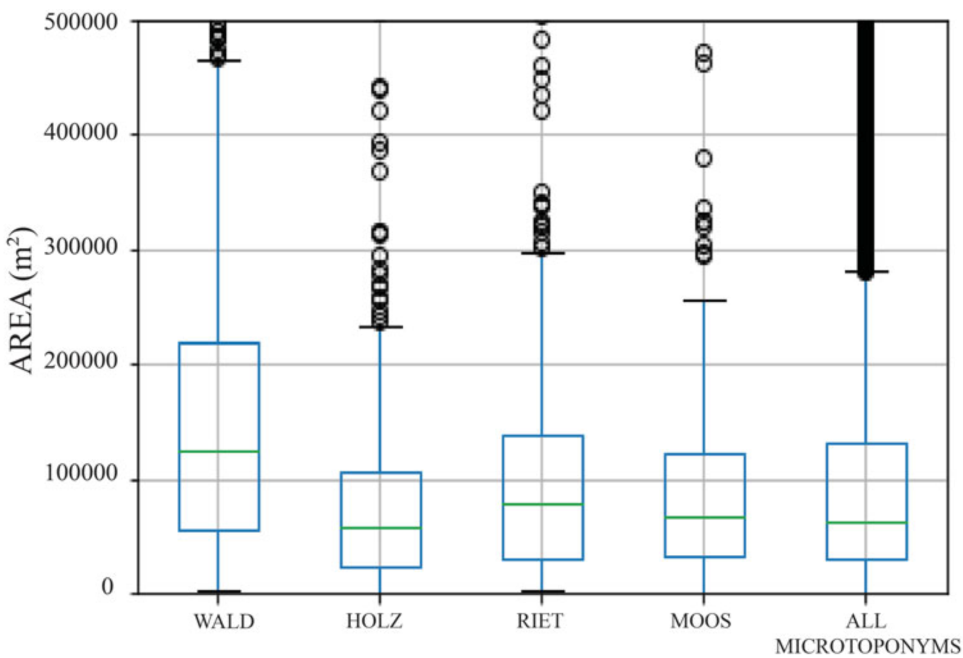

Figure 3 *Areas of Wald, Holz, Riet, and Moos polygons.*

is associated with slightly less rough or steep polygons. Finally, *Riet* is associated with the lowest elevations and smoothest polygons. This relationship suggests that the semantic associations relating *Holz* to land use are also represented in its physical properties, with it more likely to be found near settlements and on slopes amenable for forestry activities. Interestingly, we also find a clear difference in the physical properties of locations associated with *Riet* and *Moos*, with *Moos* more likely to be on lower, valley floor locations.

Because *Moos* and *Riet* are both terms historically related to undrained or marshy locations, we calculated the TWI (Beven and Kirkby 1979) to quantify the potential wetness of these sites based purely on terrain data using the following equation:

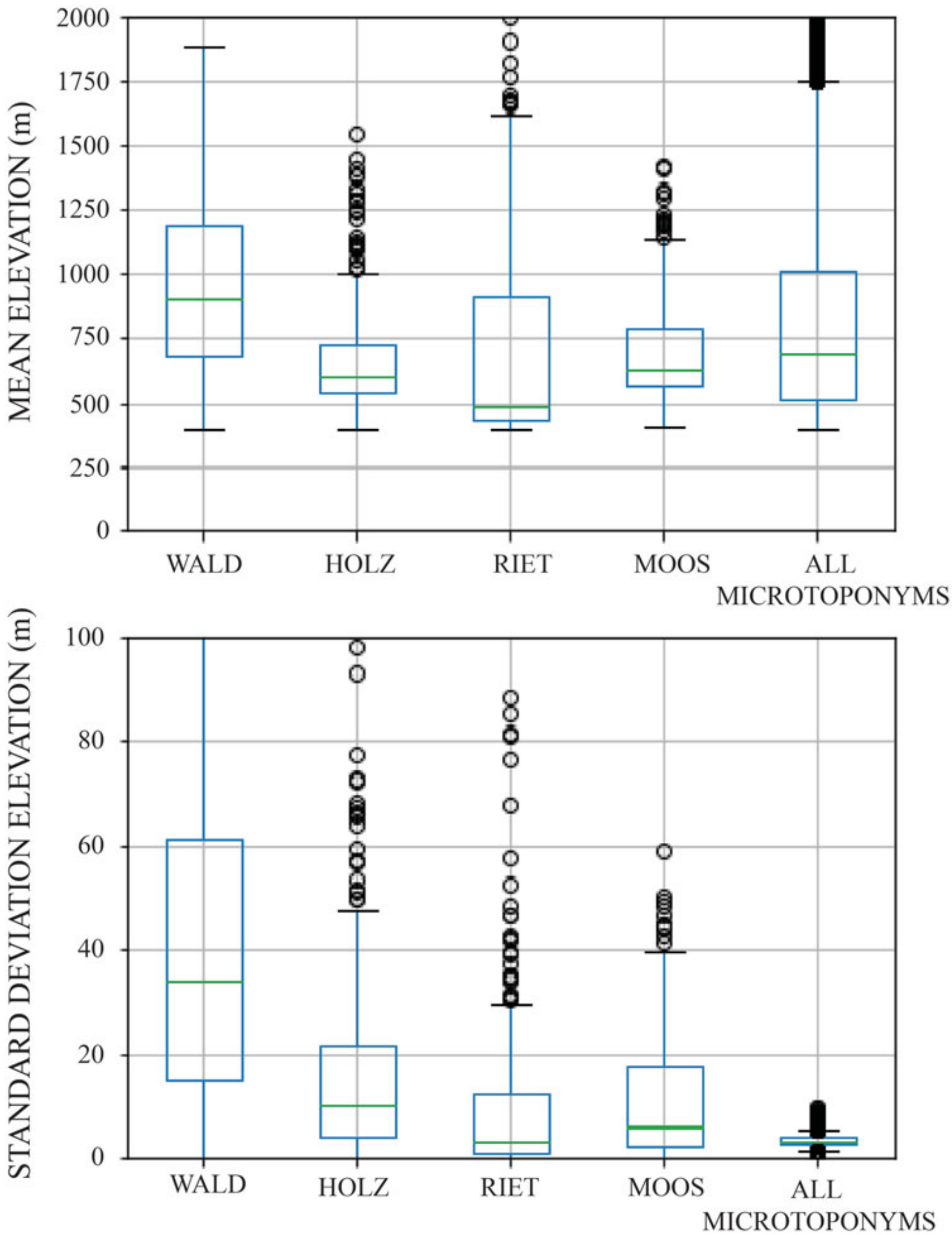

Figure 4 *Mean and standard deviation elevation of Wald, Holz, Riet, and Moos polygons.*

$$w = \ln\left(\frac{A_S}{\tan\beta}\right), \quad (1)$$

where w is the TWI, A_s is the specific catchment area, and β is the slope gradient.

In Figure 5 we see a clear pattern related to the expected physical properties of the meaningful elements. *Wald* and *Holz* are associated with lower than average values of TWI, confirming their likely locations on well-drained valley sides. Both *Riet* and *Moos* have TWI values higher than the median for all microtoponyms, suggesting that these do indeed refer to locations more likely to be poorly drained. Their properties differ considerably, however, with the low-lying, flatter *Riet* locations having median TWI values similar to the 75th percentile of *Moos*.

These results suggest that the physical properties of our four referents do indeed vary and thus that differences between the meaningful elements associated with these terms might capture physical properties associated with individual referents. Thus, *Riet* and *Moos* (and *Wald* and *Holz*) are used to describe physically different landscape features, not necessarily in terms of their

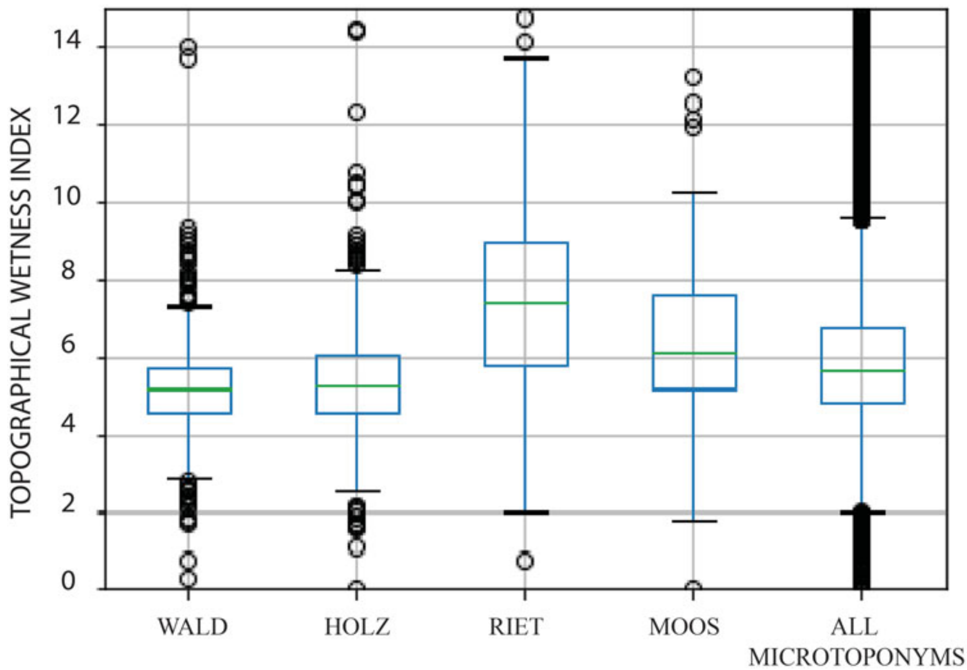

Figure 5 *Topographic wetness index for Wald, Holz, Riet, and Moos polygons.*

individual properties (i.e., both are associated with wet, poorly drained locations) but rather in terms of their landscape settings. As we described earlier, *Riet* seems to be more commonly used for low-lying, flatter locations near the valley floor, whereas *Moos* is associated with poorly drained locations found in similar landscapes to *Holz*, with *Wald* being associated with the highest, roughest landscape parcels.

Conclusions and Further Work

Our starting point, inspired by ethnophysiography, was an investigation of landscape using rich linguistic data. Given an exhaustive set of fine-grained toponyms and associated polygons, together with detailed etymological information, we quantitatively explored the semantics and physical properties of four generic landscape terms—*Wald*, *Holz*, *Riet*, and *Moos*—in the Swiss canton of St. Gallen. Starting from the assumption that microtoponyms encode meaningful information about their referents, not only individually but also at the landscape scale, we were able to describe and compare the four generic terms in terms of both semantics and geomorphometry.

Ninety-one percent of the 1,833 microtoponyms associated with our four generic terms contained terms from our lexicon, providing a rich basis for further analysis. Using our lexicon and a toponym taxonomy (Gammeltoft 2005), we were able to explore broad patterns of naming. In general, all four landscape terms were most commonly associated with generic landscape feature terms, shape, and objects. *Holz*, however, was more commonly associated with spatial relations and plant (tree) types than the other three classes. By further exploring how similar naming patterns at the class level were for the four landscape types, we confirmed that *Holz* appeared as a landscape feature to be described differently than the other three classes. By exploring individual terms associated with landscape terms, we observe further that some 50 percent of the most commonly used meaningful elements were shared between classes. Thus, on the one hand, these meaningful elements appear to be characterizing more general properties of the landscape, independent of the feature type being described. On the other, they also capture some specific properties associated with such landscape terms, as suggested by the difference between *Holz* (wooded areas often associated with land use) and *Wald* (forest more generally). We sound a note of caution here, though. Our methods cannot distinguish between meaningful elements assigned to a referent because of its specific properties (e.g., *Rossmoos* where horses grazed on this moor) and the influence of language on naming. Here, we suppose that general associations of a landscape term with particular properties might also influence the use of meaningful elements, irrespective of the actual physical properties of a referent. Our analysis, based on describing and comparing generic terms exhaustively within a given landscape, clearly demonstrates that microtoponyms are not senseless but nonetheless that an individual name and its referent can only be interpreted as "probabilistic implications, nothing logically stronger, even though the probability in a given case could be extremely high—the implied categorization should always be taken as falsifiable in principle even if not yet falsified" (Coates 2006, 365). Such a probabilistic interpretation, however, lends itself well to our quantitative approach, because we can summarize and link properties to classes of referents, without making assumptions about meaning at the level of individual referents.

This approach is demonstrated best by our analysis of the physical properties of the geomorphometry associated with classes of microtoponyms. Here, we observe that geomorphometric measures captured some of the semantic properties we associated with landscape features based on our first analysis; for example, *Wald* is associated with higher, steeper, and presumably less accessible locations than *Holz*, and *Riet* is in general wetter, flatter, and lower lying than *Moos*. One possible suggestion for understanding patterns of naming is revealed by the different patterns we note with respect to *Holz* on the one hand and *Riet*, *Moos*, and *Wald* on the other. We hypothesize that this difference reflects one landscape term being primarily associated with a land use, whereas the other three better capture land cover. We suggest that the act of naming is thus driven by a higher hierarchical semantic level where a primary distinction is between nature and culture.

Importantly, our use of physical properties and the interpretation of our results was only possible given the detailed semantic analysis we undertook at the level of landscape classes. Thus, our results demonstrate how interdisciplinary approaches to understanding patterns of naming can help us not only to explore patterns but also reveal questions and generate hypotheses for future research. We argue that much greater care is needed in exploring and associating naming patterns of individual landscape elements uncritically because our results demonstrate that a range of factors influence naming within a landscape. These go beyond the properties of individual referents and are linked to landscape patterns as a whole, associations within a landscape during the naming process, language structure, and conventions and the need for individual microtoponyms to be salient in the act of naming. Answering these questions requires methods that not only address the issue of "What does it mean for X to be called X?" but also "How do we, or should we, express terminologically the elements in system Y (and the relations among them)?" (Coates 2013, 1–2). We demonstrate in this article that etymological studies focusing on the former question can provide not only an important input to exploring the latter question but can in turn be informed by such a view. Thus, we suggest, in addition to Tent (2015), that such approaches might be complementary.

We conclude by proposing that microtoponyms, providing that the approaches taken are sufficiently robust and linguistically informed, can provide powerful ways of exploring landscape character through space, culture, and language (Atik and Swaffield 2017). It is important to acknowledge, though, that our results are dependent on the data with which we worked, and both the polygon boundaries and the names preserved over time not only represent landscape but are also the result of a political and cultural process. ■

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Note

[1] Because we are working with Swiss-German placenames, we give a translation in brackets on the first occasion that we introduce a term. Note that these translations are supposed to aid the reader and that the semantics of terms might be more complex. In German, all nouns are capitalized, and we follow this convention here.

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